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Provision and exchange of data for automated driving in road traffic

Abstract

Automated driving in road traffic has the potential to make a significant contribution towards a safer and more efficient overall transport system. But this will only be possible if the vehicles are connected with one another and their environment. Thanks to digital connectivity it will be easier in the future to more effectively optimise traffic flow, provide more needs-based mobility services and further enhance road safety. The importance of connectivity will become greater as the degree of automation increases.

Automated and connected vehicles place high demands on the availability, use and exchange of data. They require significantly more, and more reliable, static and dynamic data than are necessary for the provision of multimodal transport services. The data have to always be kept up to date and permanently available, and also have to depict the vehicle's precise location. But they also have to be rapidly, reliably and securely exchangeable. In addition, automated vehicles will have to undergo a constant learning process in order to continually improve driving behaviour in terms of road safety and traffic flow. This has to take place with human support (programming), as well as on its own through machine learning and other artificial intelligence processes. The learning process can be significantly accelerated in that vehicles exchange their sensor data with one another relating to their driving environment and the obtained findings.

Developing a jointly operated and self-learning data exchange is one promising option for securing the provision and exchange of data among all involved stakeholders. In this data exchange, the data are entered, verified, constantly updated and made accessible to all stakeholders. There is additional need for action concerning the acquisition and provision of the necessary data, the provision of a high-performance and secure communication infrastructure and the clarification of social issues in the areas of data protection and the use of artificial intelligence.

The questions of how quickly automated vehicles will be put into regular operation and how society will use them remain largely unanswered. With regard to the clarification of certain central aspects such as standardisation, cyber security, artificial intelligence, etc., Switzerland is to a large extent dependent on developments at the international level. Despite these uncertainties, Switzerland has to prepare itself for the introduction of automated vehicles and create the necessary conditions for the provision and exchange of the required data. The Federal Department of the Environment, Transport, Energy and Communications (DETEC, represented by FEDRO) is proposing a package of measures that can be implemented in an agile way and coordinated with the other related activities of the federal government.

Contents

1. Current situation and content of the report

1.1. Background information

Research and development activities are currently being carried out intensively in the field of automated driving, which has the potential to enhance road safety, increase the efficiency of the use of the infrastructure and facilitate new mobility services. When it will be possible to introduce the use of fully automated vehicles is not yet known, but already today a variety of driver assistance systems are being installed in vehicles to provide drivers with increasing support. These systems will be constantly improved until it becomes possible for automated vehicles to be operated on the road network without the intervention of a driver. This development will take place in several stages and will place high demands on the availability and exchange of data between vehicles and with the required infrastructure.

The Federal Council wants to exploit the potentials of digitalisation in the mobility sector and at the same time minimise the associated risks. This report focuses on the provision, exchange and use of the data that are required for the operation of automated road vehicles. It describes the associated challenges and outlines various measures and options for action.

1.2. Mandate from the Federal Council

In its report on the framework conditions for a digital economy ("Rahmenbedingungen der digitalen Wirtschaft")[1] the Federal Council entrusted the Federal Department of the Environment, Transport, Energy and Communications (DETEC) with the task of examining the respective legal bases relating to multimodal mobility services and the availability of data in general. As a first step, the Federal Office of Transport (FOT) conducted a broad-based stakeholder process in 2017 and prepared a discussion paper for the attention of the Federal Council.

Based on the above paper, the Federal Council entrusted DETEC with the following five mandates:

- To prepare a document for consultation concerning the promotion of multimodal mobility, focusing on a regulated liberalisation of public transport services
- To prepare a report on the required data for the operation of automated road vehicles
- To intensify international exchanges relating to data and automated driving
- To develop an action plan concerning data relating to multimodal mobility services
- To develop an action plan concerning the operation of multimodal mobility services

This report fulfils the second of the five mandates. The FOT is responsible for mandates 4 and 5, concerning which it will also be reporting to the Federal Council at the end of 2018. A joint report on multimodal mobility and the action plans formulated by DETEC will also be prepared.

1.3. Content of this report

The structure of this report is as follows:

- In Chapter 2 the importance of the data relating to automated driving is placed into the context of the other associated activities of the federal government.
- Chapter 3 deals with the main requirements associated with the operation of automated vehicles concerning the provision and exchange of data. It also describes the required data and outlines a potential solution.
- Chapter 4 deals with the challenges that are associated with the provision and exchange of data.
- Chapter 5 describes the specific need for action.

[1] **Swiss Confederation (2017):** Report on the central framework conditions for a digital economy. Federal Council, 11 January 2017.

2. Integration and delimitation

2.1. Integration into the federal government's data policy and "Digital Switzerland Strategy"

In March 2017, the Federal Council defined the overlying objectives of its data policy: access to open data as a resource for a digital economy and society, contemporary and coherent legal bases, plus framework conditions with which Switzerland is able to position itself as an attractive location for the creation of added value through data. On 9 May 2018, the Federal Council defined the initial key parameters of its data policy and ordered measures relating to open data and the transmission of personal data (portability). Here the semi-public enterprises, SwissPost, Swiss Federal Railways and Swisscom, are required to submit annual reports to the Federal Office of Communications (OFCOM) concerning their open data activities, as well as to draw attention to any action that may be required and publish the corresponding data on the "opendata.swiss" platform. In the field of research, the question of which additional bases will have to be created in order to make suitable data more readily accessible to everyone will have to be examined. The development of a data policy is an integral part of the "Digital Switzerland Strategy" that the Federal Council adopted on 5 September 2018 for the next two years.

The main focus of the Federal Council's "Digital Switzerland Strategy" is on the consistent exploitation of the potentials afforded by digitalisation, so that Switzerland can retain its position as an attractive place to live and as an innovative and forward-looking location for business and research. In order to accomplish these goals, the strategy defines various guidelines and fields of action. It describes how the authorities, the economy, science, research and civil society need to work together so that the transformation processes associated with digitalisation can be structured to Switzerland's benefit. The implementation activities of the federal administration will be published in the action plan, which also encompasses selected projects of external players, including those relating to the digitalisation of mobility.

2.2. Delimitation

Automated driving is associated with a broad variety of technological, social and regulatory facets. In its report in response to Leutenegger Oberholzer postulate 14.4169 concerning automated mobility,[2] the Federal Council cited the potential impacts and the various challenges that arise for the federal government in its role as regulator, infrastructure operator and provider of services.

This report focuses on the demands placed on data and the exchange thereof in order to efficiently facilitate automated driving for the transport of passengers and goods on the overall Swiss road network, as well as in cross-border transport.

The report does not deal with options for the use of automated driving data that are associated with the provision of other services (for example, placement of advertising in vehicles), nor with issues relating to the communication technologies to be deployed (4G/5G or ITS-G5), or comments concerning any necessary modifications of legislation.

[2] **CH (2016):** Automated driving – consequences and impacts on transport policy. Report by the Federal Council.

3. Current status of knowledge regarding the requirements placed on data by automated vehicles

Originally, manufacturers thought it would be possible for automated vehicles to be operated without special requirements, but a variety of players are now making far-reaching demands in terms of the provision of real-time data concerning the condition and navigability of roads. It is not yet clear which demands in terms of data will ultimately have to be met. This issue is currently being debated. The following conclusions may be drawn, however, based on the current status of knowledge:

- The connectivity of vehicles with one another and with the infrastructure will be a requirement (cf. Chapter 3.1)
- High demands will be placed on the quality and the reliable exchange of data (cf. Chapter 3.2)
- More detailed and more comprehensive data will be required than for the provision of multi-modal travel information (cf. Chapter 3.3)

3.1. Connectivity of vehicles

In the future, automated vehicles will account for a significant proportion of the overall transport volume. In view of this, their use should be oriented on society's mobility objectives. It will be up to society to negotiate how the ideal mobility system with automated driving will look. With DETEC's 2040 orientation framework, "Switzerland's Future Mobility",[3] Switzerland has defined initial key parameters with the basic message, "All aspects of the overall transport system are to be efficient", and the "Digital Switzerland Action Plan" is oriented on the principle that mobility is to be smart, connected and efficient. The connectivity of vehicles is an essential prerequisite for realising the necessary efficiency gains in the transport system and improving machine learning.

Efficiency gains call for comprehensive connectivity

It will not be possible to realise the targeted efficiency gains with an "autonomous" concept, i.e. the use of automated vehicles that acquire all the necessary data themselves and travel autonomously on the roads. In order for vehicles to be able to effectively coordinate themselves with other road users and to optimally utilise the available capacities, the highest possible degree of connectivity of vehicles in both the passenger and the goods transport segments will be required.[4]

Connected vehicles have to constantly exchange data before, during and after the journey with:

- Other vehicles (vehicle-to-vehicle communication, V2V)
- The infrastructure (vehicle-to-infrastructure communication, V2I)
- Where feasible, other road users such as pedestrians, cyclists, motorcyclists and transported goods (vehicle-to-everything communication, V2X).

Comprehensive connectivity results in a cooperative intelligent transport system (C-ITS).

The potentials of digital connectivity are diverse and are constantly developing. They range from improvement of traffic flow (for example through the provision of optimal speed information for using the green wave or reducing safety distances) and enhancement of road safety (for example through the provision of warnings in the vehicle about traffic jams or roadwork sites), through to the provision of more efficient mobility services such as car sharing, car pooling and other multimodal options. Thanks to digital connectivity it will be easier in the future to optimise traffic flow, combine journeys, provide more needs-based mobility services and use existing inter-modal forms of transport. The importance of connectivity will become greater as the degree of automation increases.

[3] **CH (2017):** Switzerland's Future Mobility – DETEC 2040 orientation framework.
[4] **CH (2016):** Automated driving – consequences and impacts on transport policy. Report by the Federal Council.

At the international level too, the greatest possible degree of connectivity of vehicles is regarded as an essential requirement. This principle has also been specified in, for example, the EU strategy for cooperative, connected and automated mobility.[5] Furthermore, Directive 2010/40/EU cites interfaces between vehicles and road infrastructure as one of four principal requirements.[6]

This year, Austria is initiating the implementation of a cooperative intelligent transport system (C-ITS) and thus connecting vehicles and road infrastructure.[7] This means that a variety of services (for example, warnings about roadwork sites) will be provided with the aim of enhancing road safety. However, it is not yet clear which technology for the transmission of this kind of information will be selected at the international level.

Connectivity accelerates machine learning

To optimise their behaviour on the road, automated vehicles have to undergo a constant learning process. This calls for automated modifications of the software as well as periodical updating of the hardware. Machine processes are already required for updating the fundamentals such as topographic data.

All this has to take place with human support (programming), as well on its own, through machine learning and other artificial intelligence processes. The learning process can be significantly accelerated in that vehicles exchange their sensor data with one another relating to their driving environment and the obtained findings. Through the use of machine learning technologies, automated vehicles and road users become an integral part of the “Cognitive Internet of Things (CIoT)” with the resulting data updates, specific findings and solution strategies.

3.2. High demands on the quality and availability of data

The data for automated vehicles have to meet extremely high demands in terms of quality and availability. They have to ensure precise and detailed positioning of the vehicle and be kept constantly up to date and available at all times. But they also have to be rapidly, reliably and securely exchangeable. Automated vehicles have to be fully aware:

- Whether the data are provided from a legitimate source
- How high the data quality is
- How up to date the data are
- Whether the data are informative in nature (for example, concern a route recommended by a navigation service provider)
- Or whether they concern a compelling traffic measure (for example, a diversion ordered by the traffic police).

It will also be necessary to ensure that no data are provided that are contradictory or give rise to undesirable outcomes. Here, for example, it would be highly undesirable if a diversion were to be proposed via radio while at the same time information contradicting this recommendation were to appear on the vehicle’s dashboard display.

[5] **European Commission (2016):** A European Strategy on Cooperative Intelligent Transport Systems (C-ITS), a milestone initiative towards cooperative, connected and automated mobility. Commission Communication.

[6] **EU (Directive 2010/40:** Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.

[7] **BMVIT (2016)**: Austrian C-ITS Strategy.

3.3. Data required by automated vehicles

More detailed and more comprehensive static and dynamic data are required for automated vehicles than are necessary for multimodal travel information. Additional and higher demands apply in the following areas:

- Precise and reliable positioning
- Static map data
- Dynamic data
- Data for dealing with events, etc.
- Data relating to the status of software and hardware

Precise and reliable positioning

Mobility data are always linked to a location. In Europe, “TMC Location” has been in use for 30 years for localisation of traffic bulletins. TMC (Traffic Message Channel) locates incidents using general geographic data in the form of a special “graph”, which depicts selected objects (for example, motorway junctions) and the lines in between with the pertaining properties such as a two-lane motorway with a length of 12.4 kilometres.

Navigation service providers use this method for providing routing information in highly detailed form. With its Graph Integration Platform (GIP), Austria has created an extremely dense, detailed and universally applicable “location network” (http://www.gip.gv.at/). Because it can be used universally, the Austrian authorities use the GIP at the municipal, regional and national levels, and thus ensure that the incorporated data are constantly updated. Automated vehicles need highly detailed graphs of this nature.

Static data

Automated vehicles require highly detailed map material, which has to depict reality *in real time* as accurately as possible, be kept constantly up to date and display the precise location. The required details include:

- The number of traffic lanes, together with their widths and overhead clearance, plus the generally applicable rules for motorways, urban roads, etc., including the respective maximum allowable speed
- Fixed road signs, for example for one-way roads, local turn lanes, applicable speed limits
- Bend radii
- Road surfaces
- Exact and spatially located arrangement of intersections, motorway junctions, parking spaces, rest areas, etc.
- Local road use restrictions, for example weight limits, bans on heavy goods vehicles, etc.
- etc.

In its Commission Delegated Regulation on real-time traffic information services[8] the EU imposed minimum requirements on the exchange of static road traffic data, including a national point of access to the data.

Automated as well as many new conventional vehicles are equipped with a variety of sensors, which facilitate the provision of similar and supplementary data, for example for the detection of road signs via video and the condition of the road surface based on the movements of shock absorbers. The information from these sensors can be used to supplement, verify and update these data.

Dynamic data, event data

The physical characteristics of roads and traffic constantly change. In order to keep their operation safe and efficient, the associated dynamic data have to be kept *up to date and reliably* placed at the disposal of automated vehicles. This concerns the following data in particular:

[8] **EU Commission Delegated Regulation 2015/962**: Commission Delegated Regulation (EU) 2015/962 of 18 December 2014 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services.

- Reliable and precise positioning of vehicles
- Locations of roadwork sites (including lane widths, diversions, indicated speed limits, etc.)
- Temporary lane closures and other operational measures such as speed limits, etc.
- Changing road signs (speed harmonisation systems, traffic lights, etc.)
- Indication of traffic situations (beginning and end of traffic jams, accidents, objects on the road)
- Adverse conditions (heavy rainfall, ice, snowfall)
- etc.

Many of these data are also covered by the EU Commission Delegated Regulation relating to real-time traffic data.[9] The EU has also issued detailed regulations governing safety-relevant traffic information[10] that has to be provided (free of charge where possible) by all service providers (not only the relevant authorities).

Data for dealing with events, etc.

Automated vehicles have to be able to cope with an extremely broad variety of traffic situations. In order to speed up the associated learning process, the various applied strategies have to be acquired and exchanged with one another. These include:

- Unusual situations such as navigating an underground roundabout, circumnavigating illegally parked vehicles, avoiding obstacles on the road, etc.
- Accidents or near-accidents
- Adverse conditions such as heavy rainfall or snowfall
- etc.

If these data are not used for continually improving the software in automated vehicles, the latter will continue to show behaviour similar to that of over-cautious learner drivers over a lengthy period of time. To alleviate this problem, some of the vehicles currently undergoing trials upload their daily event data to their manufacturers, who then analyse them and transmit new algorithms to the vehicles concerned. This process is very complex, and because the need constantly arises to assess new situations, the pace at which a learning result can be achieved tends to be rather slow. However, machine learning incorporating all available data could speed it up considerably.

Hardware and software data

The status of hardware and software data has to be clearly indicated. The term “hardware” refers not only to control electronics, but also to motors, brakes, etc. Vehicle manufacturers need these data so that they can update the hardware and software without delay. It is especially important for the software to be constantly updated. Both the hardware and the software gain in importance as the degree of automation increases.

Furthermore, in the future for certain stages of automation an automated vehicle will have to be able to indicate when (if at all) a driver was responsible for steering and controlling it, and when it was operated without a driver. This information is necessary in order to clarify responsibility in the event of an accident or failure to obey traffic regulations.

[9] **EU Commission Delegated Regulation 2015/962**: Commission Delegated Regulation (EU) 2015/962 of 18 December 2014 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services.

[10] **EU Commission Delegated Regulation 2013/886**: Commission Delegated Regulation (EU) No 886/2013 of 15 May 2013 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users. Official Journal of the European Union, 18 September 2013.

3.4. Jointly operated and self-learning data exchange as a potential solution

In order to be able to provide the necessary data and meet the cited requirements, a variety of conditions will have to be met. Securing communication, organising data access, providing cartographic content and other data, organising data flows and implementing learning processes are generally regarded as the most important components of comprehensive connectivity.[11]

The provision of a **jointly operated data exchange** appears to be a promising solution. Here, all involved stakeholders supply data and at the same time benefit from already provided data. Automated vehicles need a data exchange in order to:

- Secure and constantly improve the functioning of their systems
- Coordinate with other road users
- Exchange experiences in coping with certain traffic situations and speed up the associated learning process.

Other market participants can use the data in order to "refine" them and develop their own business models.

Machine processes are already necessary for ensuring the best possible updating of the data. But with the aid of artificial intelligence processes it is also possible to process intentions and experiences and thus achieve a more efficient learning result; **the data network becomes self-learning**.

This type of data network can only function successfully if the **conditions of use** between all road users, the intermediate service providers, the manufacturers and the relevant authorities, are **uncomplicated and as uniform as possible**. It is only in this way that rapid implementation will be possible among almost all road users.

From today's perspective it is to be assumed that the simplest solution would be to organise the data network on the basis of the **principles of "conditional open data"**. Here the data are freely accessible. Anyone can obtain them, but they must also supply data themselves if a business model is being operated with the obtained data. The expanded data are then available to everyone again and can be used for new applications, with the exception of "refined data", i.e. information, which can continue to be traded on the market. All involved stakeholders need to negotiate together where the boundary lies between data and information.

[11] **ITS-CH (2015):** Priority topic: Developments in neighbouring countries offer potential for synergies. A closer look at the topic: virtual infrastructure, FEDRO, 26 November 2015.

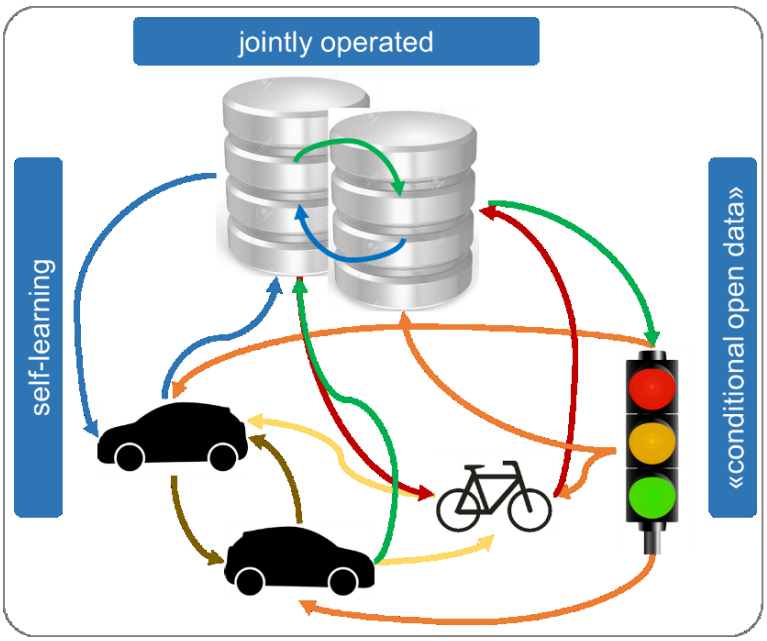

Figure 1: Jointly operated and self-learning data network based on conditional open data

4. Challenges

The provision, exchange and use of data are associated with a variety of challenges that arise from social issues and from the conflict between the status quo and the needs associated with the most efficient possible operation of the overall transport system.

4.1. Uncertain developments and social aspects

Timing and form of introduction largely unclear

The questions of how quickly automated and connected vehicles will be put into regular operation and how society will use them remain largely unanswered to date. The only thing that is clear at this time is that the existing transport system has to be made significantly safer and more efficient, and that automated vehicles can contribute towards this objective.

Despite these uncertain developments, Switzerland has to prepare itself for the introduction of automated vehicles and create the necessary conditions for the provision and exchange of the required data.

Data protection and social acceptance

In its maximum form, a jointly operated and self-learning data network could give rise to fears of undesirable surveillance and loss of control. Data in the transport sector are essentially linked to people, and are thus personal in nature.[12] In view of this, the stringent data protection provisions will have to apply.

This paves the way for a conflict of objectives between the interests of data protection and the targeted efficiency gains in the transport system. In a political process, society must negotiate to what extent protection of personal data is to be weighted higher than the interests of the general public in achieving the most efficient organisation possible of mobility. Specifically, the following questions have to be answered:

- Which personal data of road users must or can be made electronically available?
- How are these data to be processed?
- Who is responsible for the data?

It is conceivable that some facets of this conflict of objectives could be eliminated through technical measures such as data anonymisation. With the chosen solution, it will be necessary to examine the prerequisites in accordance with data protection legislation, as well as to carry out impact assessments of potential risks.

Use of artificial intelligence

In automated vehicles, it will only be possible to process data using artificial intelligence. This already applies if data in the vehicle are to be depicted consistently versus other data, and especially for automated levels at which data trigger direct responses such as braking the vehicle.

The use of artificial intelligence in automated vehicles is a central requirement so that they can learn on their own and constantly improve their ability to cope with complex traffic situations. Dependence on artificial intelligence becomes greater in line with the increasing degree of automation and connectivity of the vehicles.

If the overall transport system is to be efficient in every aspect, this dependency will become even greater due to the mutual integration of data and self-learning, through to a self-learning data network. This raises the question of who is to control this system. Society will need to clearly decide which framework and which limitations it wants to impose on artificial intelligence and automation.

[12] **EU (C-ITS 2016):** C-ITS Platform: “Final Report”. EU DG MOVE, Brussels, January 2016. http://ec.europa.eu/transport/themes/its/c-its_en.htm

4.2. Provision of data

The provision of data will require comprehensive cooperation

Data are a decisive factor for the production of modern business models. The relevant players do not surrender control over their datasets without receiving something in return. If data are provided, this often goes hand in hand with restrictions or is carried out in return for remuneration. Thus the exchange of data between the individual players does not yet take place to the desired extent. If the targeted efficiency gains are to be achieved, however, as many players as possible will be required who provide their data and exchange them among themselves. The "conditional open data" model, which distinguishes between "free data" and "information that can be traded on the market", points to a potential way out of this dilemma. Here the question has to be clarified as to how the equivalence of obtained and supplied data can be assured. In addition, it will be necessary to clarify how the data network is to be structured and how the costs for its operation and further development are to be distributed.

Internationally coordinated standardisation is essential

The cross-border use of automated vehicles will not be possible without internationally coordinated standardisation. Standards will facilitate the exchange of data between the various players and reduce misunderstandings between providers and recipients. In particular, the use of artificial intelligence, the exchange of data and specification of their quality, cyber security and the distinction between data and information will have to be based on comparable processes. Here, too, Switzerland is to a large extent dependent on international developments, but also has the opportunity to influence new developments.

4.3. Technical prerequisites

High-capacity communications infrastructure

The various data flows and anticipated volume of data will increase the demands placed on the communications infrastructure. Infrastructure with sufficient capacity will be required that covers densely the entire country and assures a high degree of reliability.

It is not yet clear which transmission technologies will be chosen at the international level. Switzerland has to continue to participate in the corresponding international talks and actively monitor the ongoing developments. Based on the current status of knowledge, the Federal Council considers mobile cellular telecommunication technologies to be the most likely choice.[13]

Coexistence of connected automated vehicles and the analogue environment

The transition from the existing transport system to one involving automated driving will be a major challenge. In residential zones, automated and connected vehicles will also have to coexist with pedestrians, cyclists and motorcyclists in the long term. In addition, automated and conventional vehicles will have to be operated alongside one another in an interim phase. It will also be necessary to find solutions for the provision, exchange and use of the data. For example, it could be possible to use smartphones in order to integrate not yet connected road users into the data system. Here, information regarding road conditions or traffic flow could be displayed directly on a smartphone in the vehicle.

Reliability of connected systems, cyber security

Increasing connectivity and intensified data exchange between different systems will raise questions relating to reliability and security. This will especially apply in the sensitive area of automated vehicles. Cyber security will thus be of high importance, and corresponding measures will therefore have to be defined and implemented. Compared with the present-day utilisation time of a vehicle, the substantially shorter renewal cycles for hardware (control electronics, installed computer hardware, sensors, etc.) and in particular software, will pose a significant challenge.

[13] **CH (2016):** Automated driving – consequences and impacts on transport policy. Report by the Federal Council.

But the vehicles are only one component of the data network. The entire system will have to take due account of cyber security and be further developed accordingly. This also means that cyber security cases will have to be exchanged, as is the case today in the software industry and the civil aviation sector. This will be the only way to ensure that cases can be dealt with quickly throughout the overall transport system.

5. Need for action

5.1. Overview

Need for action exists at four levels (cf. Figure 2):

- Clarification of the environment
- Promotion of the provision and exchange of supplementary data
- Active support of international developments
- Implementation of additional research and pilot trials

These actions will have to be coordinated with the additional activities of the federal government in the areas of data policy, “Digital Switzerland Strategy”, multimodal mobility and geodata.

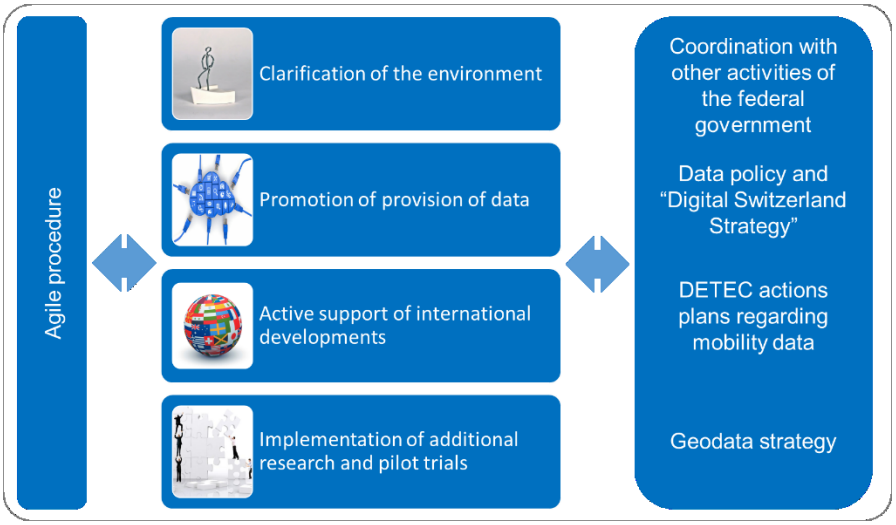

Figure 2: Overview of need for action and coordination

5.2. Clarification of the environment

Dynamics and uncertainties call for an agile approach

The introduction of automated vehicles will be characterised by high dynamics, considerable uncertainties and a strong dependence on international developments. Throughout the world, a broad variety of potential solutions to the identified challenges are being discussed and tested. It is not yet clear which solutions will ultimately be chosen. This applies to both the provision and the exchange of data for automated and connected vehicles.

This situation calls for an agile approach, which will enable Switzerland to gather its own findings and, where necessary, react flexibly to international developments. But above all it will ensure Switzerland can prepare itself in good time for the conceivable international developments and implement the necessary measures without delay. Implementing this strategy calls for comprehensive cooperation between the public sector and the industry, as well as for a certain degree of risk tolerance.

Clarification of roles and social aspects

A variety of models with differing rights and obligations exist for the roles of the public sector and the various involved players. The duties of the public sector will have to be clarified in collaboration with the involved players. Here, DETEC envisages activities within the scope of the "Mobility Data Action Plan" (guiding theme 2: governance). These will have to be supplemented and intensified for automated driving.

Furthermore, discussions on various social issues will have to be continued or initiated. In particular, this applies to the protection of data and personal integrity, as well as to the attitude of society towards an increasing dependence on artificial intelligence. Both of these issues are general topics relating to digitalisation. The specific aspects arising from the introduction of automated vehicles will have to be separated out and publicly debated. This could initially take place within the framework of the "Artificial Intelligence" interdepartmental workgroup under the leadership of the State Secretariat for Education, Research and Innovation (SERI).

5.3. Promotion of provision of data

With respect to the provision of data, as operator of the road infrastructure the public sector will have to adopt a leadership and coordination role. In this context, actions will be required in a variety of areas.

Focus on ongoing activities

For the provision and exchange of data relating to automated vehicles, the federal government can resort to various activities it has already initiated within the framework of its "Digital Switzerland Strategy" and "Digital Switzerland Action Plan". In addition, numerous activities will be addressed within the framework of the "Mobility Data Action Plan". Here, the following measures are of particular relevance for automated driving:

- Better cooperation between the various players for the exchange of data (guiding themes 1: target vision and 3: cooperation)
- Rapid enforcement of various EU directives (for example, governing the provision of a national access point for data: guiding theme 4: standards, and detailed measures 1 and 2)
- Protection of data and personal integrity (detailed measures 5 and 7)
- Provision of a graph ("Swiss Transport Network") for multimodal mobility (detailed measures 6, 7 and 8)
- Development and operation of a platform for the provision and exchange of data for multimodal mobility; study mandate (guiding theme 5: platforms, and detailed measures 7 and 8)

For automated driving, some of these activities will have to be intensified and broadened in scope. In view of the associated considerable uncertainties, a step-by-step approach will be required. Initially the following measures will have to be addressed:

Development and operation of a traffic data platform (pilot application)

The federal government will have to place its own data at the disposal of third parties. For this purpose, within the scope of a pilot application it will have to begin with unquestioned datasets such as road traffic counter data and safety-relevant traffic information, then extend these on a step-by-step basis to the provision of dynamic data.[14] For an initial provision and exchange of data the federal government is to design, develop and operate a secure and freely accessible traffic data platform as a pilot application. This is to be conceived so that it can be integrated into existing and future databases.

Creation of incentives to share data

In order to create incentives for the provision of data, the principle of "conditional open data" (cf. Chapter 3.4) is to be tested within the scope of a pilot project. For this purpose the federal government is to use the above-mentioned traffic data platform. Based on the findings from the pilot application, the federal

[14] cf. recommendations from the High Level Meeting in Gothenburg, June 2018.

government will finalise the rules governing “conditional open data” on a step-by-step basis and adapt them to the needs of the market.

If this cooperative approach fails to yield the desired result, the federal government will have to consider introducing regulatory measures for the provision and exchange of the necessary data.

Intensified coordination
Semi-public enterprises, cantons, municipalities and third parties are to be included in the development of the traffic data platform. In this way, the federal government can ensure that minor market participants, too, will be able to have access to the most fundamental data without facing financial obstacles. This will promote innovation in the mobility sector, as well as the desired interconnection of services.

In addition, the federal government wants to ensure that the cantons, cities and municipalities meet their obligations to an increasing extent to provide and exchange real-time information relating to traffic situations, roadwork sites and the operation of their roads.

Criteria for ensuring data quality
To guarantee the necessary data quality it will be essential to use a corresponding label. For this purpose, some of the EU member states have already specified minimal quality criteria for safety-relevant real-time traffic information that can be obtained via their respective national points of access.[15]

In addition, minimal quality criteria have to be specified for the respective situations, for example a minimum degree of accuracy for measuring the distance to the vehicle ahead. Furthermore, to verify legitimacy, initial authentication procedures have been developed on the basis of digital certificates.

The federal government has to ensure that the corresponding regulations are adapted to meet Swiss requirements and are implemented accordingly.

5.4. Provision of the technical prerequisites

Need to facilitate the expansion of the existing communications infrastructure
Switzerland is focusing on mobile cellular telecommunications as the communications medium. Initial implementation steps are already possible with the existing 4G networks, as has been demonstrated in Scandinavia.[16] Standards are already in place for further direct communication between vehicles on the basis of mobile cellular telecommunication technology, but they have not yet been implemented. And there are signs that, with 5G technology, communication options specially tailored to the needs of vehicles will also be available.

The federal government is to create framework conditions that will favour the expansion of a suitable communications infrastructure. Two specific measures have been envisaged in the “Digital Switzerland Action Plan”:

- The provision of new mobile cellular telecommunication frequencies
- Coordination of other forms of 5G frequency utilisation at the global level

[15] **EIP (2018)**:Update of Quality Package for Safety-Related and Real-Time Traffic Information Services: https://eip.its-platform.eu/highlights/update-quality-package-safety-related-and-real-time-traffic-information-services
[16] **Nordic Way (2018)**: NordicWay website: http://vejdirektoratet.dk/EN/roadsector/Nordicway/Pages/Default.aspx

5.5. Active support of international developments

With regard to the clarification of central aspects of automated driving, Switzerland is to a very large extent dependent on international developments. This concerns the following aspects in particular:

- Standardisation (for example, interfaces, provision of essential vehicle datasets)
- Cyber security
- Potentials and uses of artificial intelligence
- Data protection
- Data quality
- Required communications infrastructure
- Approval of vehicles, including technology to prevent manipulation
- Liability, culpability, responsibilities
- Traffic regulations

The federal government has to ensure that Switzerland closely monitors these developments, safeguards its own interests and takes the necessary steps at an early stage in order to ensure that it can exploit the associated potentials. It has to focus its efforts on committed participation in international expert groups and UN bodies (for example, the United Nations Economic Commission for Europe, UNECE), the EU (for example, the “ITS Committee”) and member states (for example, “C-ROADS”), and has to ensure that the relevant findings are disseminated in Switzerland (for example via the its-ch platform) to the involved stakeholders.

5.6. Continuation of research activities and pilot projects

The federal government wants to ensure that Switzerland positions itself internationally as a laboratory for various new concepts for needs-based public individual transport with automated vehicles. Within the framework of these activities, it will facilitate and support the implementation of additional pilot projects relating to automated driving within Swiss sovereign territory. In this way it will also enable the testing of various manufacturers’ systems and be able to obtain findings relating to the different interfaces, protocols, and data formats and models. Furthermore, pilot trials will enable the federal government to monitor the impacts of automated driving, identify any necessary regulatory requirements and ensure that the general public will gain a better understanding of automated driving.

The federal government has to ensure that the findings from pilot projects are systematically processed and placed at the disposal of all interest groups (federal administration, cantons, municipalities, players in the mobility sector).

In addition, the federal government intends to continue with the already initiated research programmes relating to automated driving and future mobility and to incorporate the obtained findings into the definition of its transport policy objectives.

Appendix 1: Overview of measures

Promotion of the provision of static and dynamic data

Development and operation of a traffic data platform

Brief description	Priority	Status	Responsibility	Required resources
Step-by-step development and operation of a traffic data platform as a pilot application within the framework of which data exchange can be tested in accordance with the principle of “conditional open data”.	High	Initiation of project, summer 2019: exchange of national and (some) cantonal road traffic counter data	FEDRO	In the initial phase possible with the existing personnel
Real-time traffic information.[17] Provision of data	Medium	Involvement in EU Commission Delegated Regulation concluded Implementation in Switzerland	FEDRO	Additional resources required
Safety-relevant traffic information.[18] Provision of data	High	Involvement in EU Commission Delegated Regulation concluded Participation in High Level Meeting workgroup Implementation in Switzerland	FEDRO	To some extent possible with the existing personnel
Provision of information relating to dynamic signalling and roadwork sites on the national roads	Medium	To be clarified	FEDRO	Additional resources required
Integration of vehicle data into national traffic management: collection and evaluation of data	High	“Vehicle to Infrastructure (V2I)” pilot trial initiated in 2017 with communication via mobile cellular telecommunications	FEDRO	To some extent possible with the existing personnel
Sensitisation of cantons and municipalities regarding the acquisition and provision of real-time information (roadwork sites, traffic jams, usage restrictions, etc.)	High	To be clarified	FEDRO	Additional resources required

[17] **EU Commission Delegated Regulation 2015/962**: Commission Delegated Regulation (EU) 2015/962 of 18 December 2014 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services.

[18] **EU Commission Delegated Regulation 2013/886**: Commission Delegated Regulation (EU) No 886/2013 of 15 May 2013 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users.

Creation of incentives to share data

Brief description	Priority	Status	Responsibility	Required resources
“Conditional open data”: legal bases for extent of data, distinction between data and information, requirement of return delivery of data	High	University of Basel project for defining fundamentals currently in preparation	FEDRO	In the initial phase, possible with the existing personnel
Testing and further development of the criteria within the framework of the “Traffic Data Platform” pilot application	High	Initiation of project, summer 2019	FEDRO	To some extent possible with the existing personnel

Incorporation of data protection

Brief description	Priority	Status	Responsibility	Required resources
Protection of data and privacy: weighing up of interests of an in all aspects efficient overall transport system versus protection of personal integrity	High	Periodical exchanges with the Federal Data Protection and Information Commissioner University of Basel project for defining fundamentals currently in preparation	FEDRO	To some extent possible with the existing personnel
Incorporation into the applicable legislation of ethical issues relating to data and responsibility	Medium	Participation in workgroups of HLM CAD and the EU	FEDRO	Additional resources required

Continuation of research activities and pilot projects

Brief description	Priority	Status	Responsibility	Required resources
Implementation of automated driving research package with “Data” subproject	High	Research package initiated in 2018	FEDRO	Possible with the existing personnel
Implementation of “Future Transport” research package	High	Research package initiated in 2017	Swiss Association of Transport Engineers and Experts (SVI)	-

Facilitation and granting of permits to carry out trials with automated vehicles	High	Intended in 2018 draft revision of the Federal Road Traffic Act	FEDRO; Federal Office of Transport (FOT); Federal Office of Communications (OFCOM)	Possible with the existing personnel
Continuation of cooperation with the Federal Institute of Technology mobility laboratory	High		FEDRO; Federal Office of Transport (FOT)	To some extent possible with the existing personnel
Examination of the option of developing a measurement system for verifying the video detection of the utilised cameras (sign recognition, detection of objects), including assessment of required resources	High	To be clarified	Federal Institute of Metrology (METAS)	Possible with the existing personnel
Development of a measurement system for checking the sensors installed in automated vehicles	High	Initiation of conceptual work, collection of initial findings	Federal Institute of Metrology (METAS)	To some extent possible with the existing personnel

Active support of international developments

Through its “Delegated Regulations”, the European Commission is currently working on the definition of the necessary regulatory framework for connectivity. FEDRO is involved in this process as Switzerland’s official representative. Furthermore, continual coordination is to be secured in a “learning by doing” approach via “C-ROADS”, a combined platform involving various European countries. Here the findings from extended pilot applications relating to automated and connected driving are to be exchanged between the participating countries.

On the vehicles side, FEDRO is participating in the workgroups of the United Nations Economic Commission for Europe (UNECE), in particular in the context of issues relating to automation and cyber security.

FEDRO is also involved in the adaptation and further development of the Vienna Convention on Road Traffic. With the existing personnel, participation is only possible to a limited extent.

Brief description	**Priority**	**Status**	**Responsibility**	**Required resources**
Creation of public key infrastructure: use of electronic certificates to secure the trustworthiness of exchanged messages between vehicles	Medium	Participation in EU workgroups	FEDRO	Additional resources required
Coordination of international and national standards	High	Participation in workgroups of the Swiss Association	FEDRO	Possible with the existing personnel

		of Road and Traffic Experts (VSS; national level), CEN, ETSI, ISO (international level)		
Coordination of data and information	Medium	Monitoring of debates in the EU	FEDRO	Additional resources required
Definition of criteria for quality assessment	High	Monitoring the activities of the workgroup “Quality" of the "European ITS Platform”; implementation in Switzerland	FEDRO	Additional resources required
Incorporation of cyber security into the applicable legislation	High	Participation in UNECE workgroups Planned participation in HLM CAD	FEDRO	Additional resources required
Restructuring of vehicle approval to reflect frequent software updates and increasing hardware updates	High	Participation in UNECE and EU workgroups	FEDRO	Possible with the existing personnel
Monitoring the EU regulations governing connected and automated vehicles	Medium	Participation in the “C-ITS Delegated Regulation” workgroup	FEDRO	Possible with the existing personnel

Interaction of automated vehicles with the analogue environment

Brief description	Priority	Status	Responsibility	Required resources
Advocating the use of smartphones, for example for displaying safety-relevant information in the vehicle, as an interim solution	High	Discussion proposed; monitoring of development in EU (Nordic Way, Talking Traffic NL)	FEDRO	Additional resources required